

Amendments to the Specification

Please replace the following paragraphs:

[0039] One suitable structure is the Marchand balun 100, shown in FIG. 1B. This classic balun implementation uses two quarter-wavelength ($\lambda/4$) sections of coaxial cable inside another coaxial shield. One section includes electromagnetically coupled lines 104 and 108, and the other section includes electromagnetically coupled lines 102 and 106. The electromagnetic coupling between coaxial line 102 and 106 and between 104 and 108 results in a signal at balun output 112 that is equal in amplitude and opposite in phase to a signal at balun output 114 relative to an input signal at balun input 110. FIG. 1B includes an exemplary impedance value of 75Ω at outputs 112 and 114.

[0040] A coaxial cable can be flattened and adapted into printable form by cross sectioning the coaxial structure and flattening the conductors into coplanar waveguides. Referring to FIG. 2A, a coplanar waveguide 202 comprises a signal trace 206 flanked on both sides by a ground 208. Signal trace 206 and ground 208 are laid on a substrate 212. Referring to FIG. 2B, a coplanar waveguide with ground 204 comprises the elements of waveguide 202 and an additional ground 209 under metal trace 206. In coplanar waveguide 204, ground 208 can be connected with ground 209 by vias 220 through substrate 212. In FIGs. 2A and 2B, the reference labels "s" and "w" represent conductor spacing width; the reference label "h" represents dielectric height of the substrate 212; and the reference label " ϵ_r " represents the dielectric constant of the substrate 212. Balun 100 is modified for printed circuit board use by transforming coaxial cable into the coplanar waveguide 202 as illustrated in FIG. 3. Vias 220, also known as plated through

holes, provide electrical connection between different layers in multi layer printed circuit boards.

[0059] Referring to FIG. 5B, an embodiment of a balun ~~501~~ 500 is presented as balun 550 with calculated element values and metal trace dimensions. Balun 550 shows common reference numbers with the balun 500 that were already discussed with reference to FIG. 5A. Balun 501 has the following electrical characteristics:

Impedance: 75Ω unbalanced in/balanced out

Bandwidth: 950-215- MHZ

Insertion loss: <0.7 dB

Input return loss: >10 db with BCM3440 Satellite Tuner LNA at output

[0066] FIG. 8 illustrates an apparatus 800 for transferring direct current power and low frequency digital control signals to low noise block 120 (see Fig. 1A) adapted for use with balun 500 (see Fig. 5A). The embodiment of FIG. 8 is presented with exemplary dimension values for the balun 800 including widths equal to 7 mils, 21 mils, 28 mils, 35 mils, and 63 mils and spacing between elements equal to 21 mils, 75 mils and 425 mils. Direct current power is defined as power supplied from a current source as direct current or from a voltage source as direct voltage. In addition to direct current power, low frequency digital control signals can be supplied to low noise block 120. A direct current power and low frequency digital control signal source 802 is coupled to spiral inductor 810. Direct current power and low frequency digital control signals can be supplied from source 802 together or either signal separately. Spiral inductor 810 is connected to balun radio frequency input 702, approximately 425 mils from balun input

110. Radio frequency input 702 is connected to coaxial cable 132 (see Fig. 1A). Coaxial cable 132 is connected to low noise block 120. A capacitor 804 is also coupled to ground 512 and to radio frequency input 702 approximately 425 mils from balun input 110. Capacitor 804 and inherent capacitance from the connection of spiral inductor 810 reduce undesirable cross over interference at balun input 110. Ground 512 is provided from vias 220. Individual vias are shown as solid dots but, for clarity, each is not labeled.

[0070] FIG. 10 illustrates balun 1000 which is an embodiment of the present invention. The embodiment of FIG. 10 is presented with exemplary dimension values for the balun 1000 including widths equal to 0.007", 0.011", 0.016", 0.020", 0.030", 0.050", 0.480", and 0.525", spacing between elements equal to 0.020" and 0.250", and diameters equal to 0.010". Balun 1000 has balun input 110 coupled to input capacitor 912. Capacitor 912 is connected to inductor 910. An input transmission line 1006 is coupled to inductor 910 and to loading capacitor 922. Capacitor 922 is coupled between transmission line 1006 and ground 512. Transmission lines 1002, 1004, and 1010 are electrically coupled to output capacitor 914 and output capacitor 916. Output inductor 930 is connected to balun negative output 920. Output inductor 928 is connected to output capacitor 914 and balun positive output 918. Tuning capacitor 926 is connected between the output side of capacitors 914 and 916. Transmission line 1006 is electromagnetically coupled to transmission lines 1002, 1004, and 1010 that results in a signal at output 918, in response to a signal applied to balun input 110, that is equal in amplitude and opposite in phase to a signal at output 920.

[0071] Ground 512 is provided from vias 220. Individual vias are shown as solid dots but, for clarity, each is not labeled. Also for clarity, diagonal lines are not used to show the location of ground 512. Elements containing vias 220 are coupled to ground 512. In the embodiment shown in FIG. 10 ground 512 is located on layer two under everything except balun. There is also a ground on layer four located beneath everything.

[0072] FIG. 10 also illustrates an embodiment of a device used to provide direct current and voltage power or low frequency digital control signals to low noise block 120 (see Fig. 1A). Direct current power and low frequency digital control signal source 802 is coupled to meandered trace 1025. Trace 1025 is coupled to balun 1000 between input 110 and input capacitor 912. Meandered trace 1025 provides a high impedance to data signal_122 to minimize undesired electrical loading of balun 1000 and low noise block 120.

[0073] FIG. 11 illustrates an alternate embodiment of a spiral inductor used to transfer direct current power and low frequency digital control signals to coaxial cable 132 (see Fig. 1A). The embodiment of FIG. 11 is presented with exemplary dimension values for the balun 1100 including widths equal to 0.007", 0.021", 0.030", 0.060", and 0.238" and a diameter equal to 0.010". Spiral inductor 1100 has direct current power and low frequency digital control signal source 802. A connection 1120 couples spiral 1100 to balun input 110. Ground 512 is provided from vias 220. Individual vias are shown as solid dots but, for clarity, each is not labeled. Ground 512 is also located under the spiral elements. For clarity the ground under spiral inductor 1100 is not illustrated with diagonal lines. The top layer ground 512 is shown with diagonal lines.